National Beef Market Basket Survey – 2006: External fat thickness measurements and separable component determinations for beef from US retail establishments

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A B S T R A C T

A market basket survey for beef retail cut composition at the retail level (four stores each from two chains in each city) was conducted in 11 US cities from January to March 2006. Beef cuts ($n = 17,495$) were measured for external fat thickness with cuts from the chuck (0.05 cm), round (0.05 cm), and miscellaneous (0.04 cm) having less ($P < 0.05$) fat than cuts from the loin (0.11 cm) and rib (0.11 cm). Beef cuts ($n = 1327$) were separated physically into separable components with round cuts having more ($P < 0.05$) separable lean (96.63%) than chuck cuts (86.81%) and miscellaneous cuts (86.18%), which had more ($P < 0.05$) separable lean than loin cuts (84.53%) with rib cuts (69.34%) having the lowest ($P < 0.05$) separable lean. Chemical fat from the separable lean differed ($P < 0.05$) between each cut category: round cuts (3.71%), miscellaneous cuts (4.99%), loin cuts (5.60%), chuck cuts (6.90%), and rib cuts (8.61%). Ground beef samples ($n = 235$), with declared lean/fat percentages ranging from 73/27 to 96/4, had overall chemical fat values of 13.41% and moisture values of 67.42%. This survey documents the current beef retail cut and ground beef composition, which is helpful to those who need this information for various dietary and marketing purposes.

1. Introduction

Composition of beef carcasses and cuts has been a long-standing research area for meat scientists throughout the world. The compilation of basic food composition data and the development of composition tables for the United States Department of Agriculture began in the late 1800s. Since the mid-1900s, continued research in beef composition by universities, agriculture experiment stations, government laboratories, as well as industry, has helped USDA to continue to update and revise nutrient information, resulting in four different versions of the Agriculture Handbook No. 8, "Composition of Foods: Beef Products; Raw, Processed, Prepared" (commonly referred to in the recent past as Agriculture Handbook 8–13).

Since 1992, beef retail cut composition and nutrient information have been maintained by the United States Department of Agriculture's National Nutrient Data Laboratory through the use of a Nutrient Database for Standard Reference. Several key findings in the beef industry during the late 1980s instigated major changes in the way beef retail cuts have been merchandized and as a consequence made data presented in Agricultural Handbook 8–13 (USDA, 1986) obsolete. The National Consumer Retail Beef Study (Cross, Savell, & Francis, 1986; Savell et al., 1989) showed that consumers preferred beef retail cuts that were trimmed to have little or no subcutaneous fat. These findings led retailers to reduce fat trim specifications to no more than 0.64 cm to meet consumer demands (Cross et al., 1986). These results also prompted the need for more research to better define the fatness of beef cuts at the

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retail level and determine to what extent retailers were trimming external fat to meet consumer demands. The National Beef Market Basket Survey (Savell, Harris, Cross, Hale, & Beasley, 1991) found retail cuts to be even leaner than was expected. Results from this study led to the work by Jones, Savell, and Cross (1992a, 1992b, 1992c) that analyzed the physical and chemical composition of beef retail cuts, raw and cooked, trimmed to 0.0 cm and 0.6 cm of external fat. Not only did these data validate the previous reports of leaner beef retail cut composition, but it also was used to update the Agriculture Handbook 8–13 at the time. Regression equations reported in the study could be used to predict the composition of beef retail cuts trimmed to 0.0 cm and 0.6 cm external fat regardless of the changes expected in the US beef carcass population throughout time. In other research, Wahrmund-Wyle, Harris, and Savell (2000a, 2000b) studied the physical and chemical composition of the separable lean for cuts trimmed to an external fat trim level of 0.6 cm, cooked; 0.3 cm, cooked; 0.3 cm, raw; and

Table 1
Least squares means ± SEM[A] for external fat thickness for retail cuts from the chuck, rib, loin, and round primals, and other miscellaneous beef cuts surveyed in the retail store

	n	External fat thickness (cm)
Chuck	3106	0.05 ± 0.01b
Rib	2266	0.11 ± 0.01c
Loin	4151	0.11 ± 0.004c
Round	4561	0.05 ± 0.004ab
Miscellaneous	3411	0.04 ± 0.01a
Total	17,495	$P < 0.0001$

Means within the same column lacking a common letter (a–c) differ ($P < 0.05$).
[a] SEM is the standard error of the least squares means.

Table 2
Means and standard deviations (SD) for fat thickness for retail cuts from the chuck and rib surveyed in the retail store

Approved URMIS[a] name	UPC[b]	*n*	Fat thickness (cm)	SD
Chuck		3106		
7-Bone pot roast	1033	53	0.15	0.13
7-Bone steak	1035	31	0.11	0.08
Arm pot roast	1048	35	0.18	0.13
Arm pot roast bnls	1049	61	0.09	0.11
Blade roast	1064	46	0.06	0.10
Blade steak	1066	61	0.07	0.08
Blade steak bnls	1073	188	0.04	0.05
Pot roast bnls	1080	325	0.05	0.06
Eye steak bnls	1102	145	0.04	0.05
Flanken style ribs	1107	163	0.05	0.08
Flanken style ribs bnls	1110	43	0.00	0.00
Mock tender roast	1115	7	0.03	0.04
Mock tender steak	1116	116	0.01	0.03
Neck pot roast bnls	1121	58	0.04	0.04
Short ribs	1124	337	0.05	0.10
Short ribs bnls	1127	120	0.02	0.05
Shoulder pot roast bnls	1132	136	0.11	0.11
Shoulder steak bnls	1133	326	0.10	0.07
Shoulder top blade roast bnls	1137	56	0.01	0.03
Shoulder top blade steak bnls	1144	194	0.01	0.02
Under blade pot roast	1150	19	0.17	0.15
Under blade pot roast bnls	1151	280	0.05	0.06
Under blade steak	1152	7	0.05	0.07
Under blade skeak bnls	1158	251	0.04	0.07
Should top blade steak (flat iron)	1166	48	0.00	0.00
Rib		2266		
Back ribs	1182	219	0.01	0.02
Ribeye roast	1192	3	0.15	–
Ribeye roast lip on BI	1193	24	0.14	0.06
Ribeye steak lip on BI	1197	544	0.13	0.09
Ribeye steak lip on bnls	1203	438	0.12	0.09
Ribeye steak	1209	934	0.12	0.08
Roast small end	1235	21	0.10	0.07
Steak small end bnls	1245	83	0.14	0.08

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

Table 3
Means and standard deviations (SD) for fat thickness for retail cuts from the loin and round surveyed in the retail store

Approved URMIS[a] name	UPC[b]	*n*	Fat thickness (cm)	SD
Loin		4151		
Ball tip roast	1307	64	0.00	0.00
Ball tip steak	1308	168	0.01	0.02
Flap meat steak	1326	5	0.00	0.00
Porterhouse steak	1330	501	0.16	0.08
Shell sirloin steak	1346	79	0.20	0.06
Sirloin steak	1358	14	0.17	0.15
T-bone steak	1369	629	0.15	0.08
Tenderloin steak	1388	517	0.05	0.08
Top loin steak	1398	306	0.18	0.10
Top loin steak bnls	1404	948	0.15	0.09
Top sirloin roast bnls cap off	1419	5	0.10	0.14
Top sirloin cap steak bnls	1421	34	0.09	0.11
Top sirloin steak bnls	1422	369	0.09	0.09
Top sirloin steak bnls cap off	1426	401	0.07	0.08
Tri tip roast	1429	52	0.03	0.06
Tri tip steak	1430	59	0.03	0.04
Round		4561		
Top round roast cap off	1454	29	0.00	0.00
Top round roast	1455	98	0.05	0.10
Bottom round roast	1464	364	0.10	0.28
Bottom round steak	1466	523	0.07	0.07
Eye round roast	1480	249	0.06	0.09
Eye round steak	1481	443	0.04	0.06
Round steak	1494	6	0.15	–
Round steak bnls	1501	162	0.23	0.29
Bottom round rump roast	1519	234	0.06	0.08
Round tip roast	1525	50	0.01	0.03
Round tip roast cap off	1526	27	0.03	0.05
Round tip steak	1527	130	0.02	0.04
Round tip steak cap off	1535	153	0.01	0.02
Sirloin tip side steak	1543	98	0.01	0.03
Sirloin tip center roast	1549	6	0.00	0.00
Sirloin tip center steak	1550	78	0.00	0.00
Top round steak	1553	674	0.04	0.08
Top round steak 1st cut	1556	363	0.03	0.05
Round for cubed steak	1577	874	0.01	0.03

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

Table 4
Means and standard deviations (SD) for fat thickness for retail cuts from other miscellaneous beef cuts

Approved URMIS[a] name	UPC[b]	*n*	Fat thickness (cm)	SD
Miscellaneous		3411		
Flank steak	1581	306	0.00	0.00
Plate spareribs	1598	15	–	–
Plate short ribs	1599	52	0.06	0.05
Plate short ribs flaken style	1603	125	0.05	0.09
Plate short ribs bnls	1605	59	0.01	0.03
Plate skirt steak bnls	1607	278	0.01	0.02
Brisket whole bnls	1615	346	0.18	0.20
Brisket flat cut bnls	1622	252	0.10	0.14
Brisket edge cut bnls	1624	10	0.00	–
Brisket point half bnls	1628	6	0.00	0.00
Brisket corned bnls	1630	25	–	–
Shank cross cuts	1636	397	0.08	0.09
Beef for stew	1727	1205	0.00	0.02
Braising strips		21	0.02	0.04
Stirfry		314	0.01	0.05

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

0.0 cm, cooked. USDA's nutritional information sources were devoid of this type of information on the separable lean tissue only. Results for chemical fat content from this study for most cuts were lower than what was reported by USDA.

It is apparent that continual work must be done to most accurately represent the ever-changing face of beef retail cut composition. Data presented in the National Nutrient Database are the foundation for a majority of the public and private work in the human nutrition field. Because this information directly impacts nutritional activities within this country, it must be the most accurate and current data available. The federal government not only uses these numbers for various disease and disease treatment research studies, but for dietary guidance and the planning of national nutritional policies as well. The objective of this study was to collect external fat thickness measurements, conduct separable component, and perform chemical fat analyses on retail cuts to gain knowledge of the composition of retail raw beef throughout the United States.

Table 5
Means and standard deviations (SD) for percentage separable components of retail cuts from the beef chuck

Approved URMIS[a] name	UPC[b]	*n*	Lean (%)		External fat (%)		Seam fat (%)		Total fat (%)		Bone and connective tissue (%)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef chuck												
Arm pot roast	1048	3	73.34	7.12	3.88	3.51	7.43	0.87	11.31	3.30	15.59	4.82
Arm pot roast bnls	1049	3	85.42	11.11	4.17	7.22	9.56	2.41	13.73	9.63	0.85	1.47
Shoulder pot roast bnls	1132	27	88.97	5.37	5.59	3.14	3.17	3.33	8.76	4.32	2.27	3.02
Arm steak bnls	1056	1	94.59		0.70		3.14		3.84		1.57	
Short ribs	1124	32	55.90	14.84	7.77	6.03	5.73	4.92	13.50	6.79	30.59	11.98
Short ribs bnls	1127	8	94.30	5.89	4.25	4.70	1.21	2.14	5.46	6.10	0.24	0.68
Shoulder steak bnls	1133	66	93.58	4.14	3.62	2.93	1.22	1.76	4.84	3.75	1.53	2.24
Flanken style ribs	1107	9	60.10	5.53	5.46	3.60	4.62	3.15	10.08	4.39	29.82	5.08
Flanken style ribs bnls	1110	1	86.61		5.29		6.45		11.74		1.65	
Neck pot roast bnls	1121	6	86.15	3.85	4.93	4.71	5.41	2.04	10.34	3.54	3.51	2.66
Pot roast bnls	1080	22	86.35	3.53	2.62	2.13	9.26	3.54	11.88	3.75	1.71	2.14
7-bone pot roast	1033	4	65.00	5.90	3.47	2.27	9.49	0.90	12.96	2.28	22.04	4.27
7-bone steak	1035	6	65.03	3.47	3.70	1.72	12.44	4.15	16.14	4.50	18.84	1.92
Blade roast	1064	4	60.95	1.24	4.33	3.52	10.59	4.24	14.92	3.46	24.13	3.70
Blade steak	1066	5	63.77	2.15	2.54	1.09	16.49	3.59	19.03	4.05	17.20	3.43
Blade steak bnls	1073	27	88.50	3.48	1.53	1.85	8.94	4.21	10.47	3.77	1.04	1.19
Top blade steak BI	1138	4	69.50	16.35	13.66	22.11	1.81	2.78	15.47	20.75	15.03	4.81
Under blade pot roast	1150	1	86.21		0.00		9.29		9.29		4.50	
Under blade steak	1152	5	82.30	6.86	1.85	1.70	8.54	3.72	10.39	4.21	7.32	9.10
Under blade pot roast bnls	1151	21	81.72	4.82	2.26	2.64	13.96	4.11	16.22	4.27	2.06	1.66
Under blade steak bnls	1158	23	86.19	5.83	1.61	1.56	10.21	5.54	11.82	6.16	1.81	2.76
Mock tender roast	1115	3	97.40	0.28	0.66	0.73	0.49	0.44	1.15	0.29	1.45	0.11
Mock tender steak	1116	62	97.54	3.33	1.09	2.27	0.06	0.29	1.14	2.26	1.28	2.57
Top blade roast bnls	1137	15	94.29	5.75	2.17	4.46	0.17	0.45	2.34	4.40	3.37	3.51
Top blade steak bnls	1144	110	97.85	4.03	0.29	0.84	0.33	1.82	0.62	1.96	1.54	3.43
Top blade steak (flat iron)	1166	7	97.87	2.44	0.92	1.17	0.00	0.00	0.92	1.17	1.21	2.02
Eye steak bnls	1102	66	83.20	6.90	4.33	3.40	9.94	4.74	14.27	5.32	2.53	4.19
Chuck average		541	87.81	13.25	2.81	4.00	4.56	5.61	7.37	7.18	4.81	9.24

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

Table 6
Means and standard deviations (SD) for percentage separable components of retail cuts from the beef rib

Approved URMIS[a] name	UPC[b]	*n*	Lean (%)		External fat (%)		Seam fat (%)		Total fat (%)		Bone and connective tissue (%)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef rib												
Roast large end	1218	3	67.97	2.24	7.14	3.13	9.68	1.05	16.82	2.87	15.21	0.65
Steak large end	1222	3	72.20	10.46	10.23	4.90	12.37	4.78	22.60	9.43	5.20	3.11
Back ribs	1182	34	34.45	6.20	9.27	5.36	10.22	5.86	19.49	7.23	46.06	7.98
Roast small end	1235	4	68.57	3.53	7.94	3.63	8.88	4.19	16.82	2.34	14.60	3.71
Roast small end bnls	1238	1	68.82		5.69		11.82		17.51		13.68	
Steak small end	1239	5	71.93	6.73	7.97	4.66	8.35	2.61	16.32	2.49	11.75	8.23
Steak small end bnls	1245	8	78.02	5.74	8.12	2.93	8.04	3.50	16.16	3.56	5.81	3.67
Ribeye steak	1209	62	80.56	6.09	6.85	4.86	10.54	5.38	17.39	6.68	2.04	2.15
Ribeye roast	1192	1	61.99		3.78		22.97		26.75		11.25	
Short ribs	1259	3	54.48	7.46	5.81	6.33	9.60	5.00	15.41	5.19	30.10	3.50
Short ribs bnls	1265	1	85.74		14.26		0.00		14.26		0.00	
Ribeye rst lip on BI	1193	7	69.45	4.69	8.68	2.64	10.43	3.72	19.11	3.65	11.44	1.66
Ribeye stk lip on BI	1197	47	68.58	7.75	6.75	3.79	10.57	4.55	17.32	4.89	14.10	6.85
Ribeye stk lip on bnls	1203	49	79.10	4.55	6.69	3.58	11.36	4.76	18.05	5.40	2.85	2.97
Rib average		228	69.34	16.76	7.35	4.37	10.52	5.01	17.87	5.84	12.79	15.82

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

2. Materials and methods

2.1. Product selection

Eleven cities were selected to allow sampling in various geographical regions of the United States with known differences in market preference. Cities sampled included: New York, NY; Philadelphia, PA; Atlanta, GA; Chicago, IL; Kansas City, MO; Houston, TX; Denver, CO; Los Angeles, CA; San Francisco, CA; Seattle, WA; and Tampa, FL. Cities were chosen to allow for comparison to the previous market basket survey and to provide additional opportunities for data collection. Two retail chains per city were selected with the chains representing at least one third of the total volume of supermarket sales in that city. Four stores per chain were chosen so that a total of eight supermarket stores per metropolitan area were sampled. Sampling occurred in the months of January to March 2006.

At the store level, external fat thickness, when present, was measured on all steaks and roasts at three different locations on the cut. These measurements were used to calculate an average external fat thickness measurement for each cut. Those cuts that were free of external fat were noted as such. Additional information that appeared on the meat label or package also was recorded. After all measurements and data were collected at the store, an assortment of 21 retail cuts, representing various locations of the carcass, were purchased from each store and shipped to the Rosenthal Meat Science and Technology Center at Texas A&M University for cut dissection and chemical fat determination. Cuts from the

Table 7
Means and standard deviations (SD) for percentage separable components of retail cuts from the beef loin

Approved URMIS[a] name	UPC[b]	*n*	Lean (%)		External fat (%)		Seam fat (%)		Total fat (%)		Bone and connective tissue (%)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef loin												
Top loin steak	1398	24	68.06	7.15	7.07	3.86	5.02	4.82	12.09	5.59	19.88	7.11
Top loin steak bnls	1404	80	83.29	5.38	10.08	6.85	3.35	3.62	13.43	7.30	3.77	3.66
Tenderloin steak	1388	66	92.33	6.66	3.20	2.69	2.01	3.47	5.21	4.70	2.46	5.07
T-bone steak	1369	49	66.56	7.30	6.56	3.18	5.55	5.28	12.11	5.89	21.74	6.61
Porterhouse steak	1330	21	69.93	4.64	6.61	4.26	6.36	4.37	12.97	4.26	17.1	3.92
Sirloin steak	1358	1	78.32		5.08		8.40		13.48		9.18	
Shell sirloin steak	1346	1	75.69		1.75		10.53		12.28		12.03	
Ball tip roast	1307	6	92.61	3.85	4.82	3.42	1.13	1.68	5.95	3.61	1.72	3.45
Ball tip steak	1308	22	95.83	3.30	2.29	2.85	1.30	1.79	3.59	3.10	0.58	1.37
Flap meat steak	1326	1	90.19		6.70		0.96		7.66		2.15	
Tri tip roast	1429	12	88.37	9.32	10.87	8.66	0.38	1.08	11.25	9.02	0.38	0.68
Tri tip steak	1430	26	92.29	6.31	6.58	5.81	0.40	1.51	6.98	6.98	0.73	1.95
Top sirloin rst bnls cap off	1419	1	90.43		8.56		0.00		8.56		1.01	
Top sirloin steak bnls	1422	26	90.70	4.12	4.74	3.29	3.27	2.99	8.01	3.90	1.29	1.83
Top sirloin stk bnls cap off	1426	33	94.15	3.77	3.12	2.79	1.54	2.13	4.66	3.04	1.19	1.86
Top sirloin cap steak bnls	1421	13	95.81	4.94	3.31	4.78	0.00	0.00	3.31	4.78	0.71	0.93
Loin average		382	84.53	11.96	6.07	5.37	2.97	3.95	9.04	6.70	6.59	8.99

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

Table 8
Means and standard deviations (SD) for percentage separable components of retail cuts from the beef round

Approved URMIS[a] name	UPC[b]	*n*	Lean (%)		External fat (%)		Seam fat (%)		Total fat (%)		Bone and connective tissue (%)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef round												
Steak	1494	1	86.07		6.21		4.08		10.29		3.64	
Steak bnls	1501	15	89.55	3.44	4.95	2.25	4.51	2.32	9.46	3.90	1.00	0.95
Top round roast	1455	6	91.61	3.45	2.41	2.16	4.19	2.85	6.60	2.62	1.79	1.98
Top round roast cap off	1454	7	98.34	1.50	1.34	1.15	0.32	0.84	1.66	1.50	0.00	0.00
Top round steak, 1st cut	1556	6	91.25	18.05	8.43	18.21	0.30	0.75	8.73	18.06	0.02	0.05
Top round steak	1553	40	97.43	3.09	1.60	2.22	0.91	1.71	2.51	3.08	0.07	0.42
Bottom round rump roast	1519	20	93.77	3.84	5.23	3.53	0.52	0.85	5.75	4.02	0.48	1.29
Bottom round roast	1464	22	91.81	4.25	5.91	3.37	1.17	1.68	7.08	4.35	1.11	1.31
Bottom round steak	1466	55	95.57	3.52	3.28	3.48	0.58	1.27	3.86	3.40	0.58	1.29
Eye round roast	1480	24	95.46	3.67	3.88	2.94	0.39	1.00	4.27	3.74	0.27	0.58
Eye round steak	1481	79	98.01	2.31	1.71	2.24	0.02	0.11	1.73	2.23	0.27	0.83
Bottom round rst (triangle)	1463	2	93.59	0.87	6.41	0.87	0.00	0.00	6.41	0.87	0.00	0.00
Tip roast	1525	5	93.95	2.63	1.09	0.65	3.35	1.94	4.44	2.28	1.62	1.54
Tip steak	1527	16	95.88	3.96	1.74	2.64	1.58	2.17	3.32	3.23	0.79	1.50
Tip roast cap off	1526	2	97.86	3.03	0.52	0.73	1.62	2.30	2.14	3.03	0.00	0.00
Tip steak cap off	1535	39	98.94	1.95	0.41	0.75	0.16	0.53	0.57	1.02	0.50	1.42
Sirloin tip center steak	1550	10	98.58	1.49	0.99	0.91	0.00	0.00	0.99	0.91	0.43	1.26
Sirloin tip center roast	1549	4	94.31	2.84	2.98	2.18	1.18	1.46	4.16	3.51	1.53	3.06
Sirloin tip side steak	1543	16	99.38	1.32	0.35	0.64	0.21	0.82	0.56	1.33	0.07	0.28
Cubed steak	1577	53	99.63	1.18	0.15	0.41	0.22	1.14	0.37	1.18	0.00	0.00
Round average		422	96.63	4.34	2.27	3.56	0.68	1.57	2.96	4.12	0.42	1.09

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b] Universal product code.

following primals or sections were selected for dissection studies: chuck blade section, chuck arm section, rib, loin, round, and miscellaneous (e.g., stew meat, stirfry, or skirt steak). Ground beef samples were obtained for chemical fat and moisture analyses. Packages were shipped in plastic coolers or insulated boxes the same day for overnight delivery.

2.2. Retail cut dissection

Upon arrival, retail cuts were identified according to the uniform retail meat identity standards (URMIS) with both the official URMIS name and UPC code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003). Cuts were removed from the package and dissected into separable lean, external fat (which may have included subcutaneous or intermuscular fat, depending on where the cut was fabricated from the carcass), seam (intermuscular) fat, and bone and heavy connective tissue (waste). Heavy connective tissue within muscles (e.g., Top Blade Steaks or the *Muscularis infraspinatus*) was not removed; however, heavy connective tissue between muscles was removed. Initial cut weight and post-dissection weights of all components were taken to ascertain the percentages of each dissected component for that cut. Dissection data were used later to determine the fatness of retail cuts. For those packages containing multiple steaks, each steak was weighed and treated independently during dissection, but separable lean was combined for powdering before chemical analysis.

2.3. Sample preparation

Separable lean from all steaks and roasts from each package were powdered to make a homogenous sample for chemical fat analysis. Powdering occurred immediately after dissection and weighing. Separable lean from each cut was submerged in liquid nitrogen and then placed in stainless steel blending cups to powder. Two Whirl-Pak bags per retail cut were filled with the resulting powdered sample and stored at −10 °C until used for chemical fat analysis.

Ground beef samples, stew meat, cubed meat, stirfry, or any other cuts that had no visible external or seam fat to remove were immediately weighed and powdered. As stated earlier, for those packages containing multiple steaks, each steak was weighed and treated independently during dissection; however, the entire package was combined as a composite for powdering. Cuts that were very large (e.g., whole briskets) were dissected into separable components with all appropriate weights collected and separable lean was sent through a small table-top grinder for homogenization. Smaller grab samples were taken from each quadrant of this homogenized separable lean for powdering.

2.4. Chemical fat analysis

Chemical fat of the separable lean from each package, as well as ground beef samples, were measured using a modified version of the oven-dry ether extraction method described by AOAC (2000).

Table 9
Means and standard deviations (SD) for percentage separable components of miscellaneous beef retail cuts

Approved URMIS[a] name	UPC[b]	*n*	Lean (%)		External fat (%)		Seam fat (%)		Total fat (%)		Bone and connective tissue (%)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef shank cross cuts	1636	58	58.66	14.79	3.77	5.32	2.99	3.16	6.76	6.48	34.65	12.31
Beef Brisket												
Whole bnls	1615	3	71.83	14.95	15.50	6.87	12.67	11.72	28.17	14.95	0.00	0.00
Point half bnls	1628	1	87.26		12.74		0.00		12.74		0.00	
Flat half bnls	1623	14	86.15	5.33	12.68	5.49	1.17	3.16	13.85	5.33	0.00	0.00
Middle cut bnls	1626	2	77.47	3.29	18.37	1.69	4.16	4.99	22.53	3.29	0.00	0.00
Flat cut bnls	1622	18	91.88	7.14	7.04	7.12	0.45	1.12	7.49	7.25	0.63	1.92
Point off bnls	1629	5	89.65	3.37	9.94	3.54	0.42	0.94	10.36	3.37	0.00	0.00
Edge cut bnls	1624	1	78.05		5.91		16.04		21.95		0.00	
Beef flank steak	1581	38	98.20	1.65	1.46	1.55	0.16	0.67	1.62	1.54	0.18	0.46
Beef Plate												
Skirt steak bnls	1607	25	89.91	12.13	6.81	9.27	0.60	2.48	7.41	9.14	2.71	9.79
Skirt steak rolls bnls	1611	10	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Short ribs	1599	7	47.49	9.99	8.69	6.04	10.52	6.56	19.21	8.32	33.29	6.82
Spareribs	1598	1	37.86		8.95		5.61		14.56		47.57	
Short ribs bnls	1605	8	90.62	6.12	4.06	4.77	2.07	3.70	6.13	6.16	3.25	4.09
Short ribs flanken style	1603	10	62.07	6.33	3.36	3.61	8.25	7.24	11.61	6.07	26.32	4.04
Beef for stew	1727	43	96.45	13.9	1.11	3.05	0.24	1.09	1.35	3.28	0.11	0.39
Beef for stirfry		30	99.98	0.13	0.02	0.13	0.00	0.00	0.02	0.13	0.00	0.00
Miscellaneous average		273	84.23	19.95	3.97	6.05	1.73	3.88	5.65	7.60	9.75	16.31

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b] Universal product code.

Table 10
Least squares means ± SEM[a] for separable components of retail cuts from the chuck, rib, loin, and round primals, and other miscellaneous beef cuts

Percentage	Chuck	Rib	Loin	Round	Misc	*P* > *F*
Lean	86.81 ± 0.56b	69.34 ± 0.89d	84.53 ± 0.69c	96.63 ± 0.65a	86.18 ± 0.85bc	<0.0001
External fat	2.92 ± 0.19d	7.35 ± 0.31a	6.07 ± 0.24b	2.27 ± 0.22e	3.82 ± 0.29c	<0.0001
Seam fat	4.67 ± 0.18b	10.52 ± 0.28a	2.97 ± 0.22c	0.68 ± 0.21d	1.18 ± 0.27d	<0.0001
Total fat	7.56 ± 0.27c	17.87 ± 0.42a	9.04 ± 0.33b	2.96 ± 0.31e	5.00 ± 0.41d	<0.0001
Bone and connective tissue	5.59 ± 0.45c	12.79 ± 0.71a	6.59 ± 0.55c	0.42 ± 0.52d	8.47 ± 0.68b	<0.0001

Means within the same row lacking a common letter (a–e) differ $P < 0.05$.
[a] SEM is the standard error for least squares means.

2.5. Statistical analysis

Means, standard deviations, and percentage values were computed using data analysis functions in Microsoft Excel (Microsoft Corporation, Redmond, Washington). Least squares means were separated using PROC GLM with pdiff option (SAS Institute, Cary, North Carolina).

3. Results and discussion

3.1. Store data

External fat thickness measurements for cuts surveyed in the retail store are presented in Table 1. When comparing cuts originating from one of the four main primals, cuts from the round,

Table 11
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef chuck

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat (%)		Moisture (%)	
			Mean	SD	Mean	SD
Beef chuck						
Arm pot roast	1048	3	3.35	0.74	75.47	0.78
Arm pot roast bnls	1049	3	4.64	1.85	74.13	1.35
Shoulder pot roast bnls	1132	27	3.96	1.22	74.32	1.34
Arm steak bnls	1056	1	3.10		74.95	
Short ribs	1124	23	10.22	4.56	70.28	3.65
Short ribs bnls	1127	6	8.40	4.98	71.34	3.43
Shoulder steak bnls	1133	38	4.35	1.23	73.73	1.30
Flanken style ribs	1107	9	10.31	1.77	70.47	1.42
Flanken style ribs bnls	1110	1	7.45		70.87	
Neck pot roast bnls	1121	6	4.99	2.14	73.86	1.72
Pot roast bnls	1080	21	6.30	2.16	72.93	1.65
7-bone pot roast	1033	4	7.40	2.93	72.32	2.63
7-bone steak	1035	6	7.48	2.44	72.15	2.11
Blade roast	1064	4	7.92	1.59	71.93	1.44
Blade steak	1066	5	9.61	1.63	69.93	1.12
Blade steak bnls	1073	24	5.58	2.25	73.41	1.90
Top blade steak BI	1138	2	7.77	0.24	72.03	0.24
Under blade pot roast	1150	1	4.77		73.79	
Under blade steak	1152	3	7	0.44	72.04	0.52
Under blade pot roast bnls	1151	20	7.55	1.82	71.97	1.54
Under blade steak bnls	1158	19	6.41	2.57	72.76	2.22
Mock tender roast	1115	3	3.65	1.08	74.45	0.88
Mock tender steak	1116	19	3.23	1.58	75.27	1.44
Top blade roast bnls	1137	14	6.95	1.65	72.66	1.47
Top blade steak bnls	1144	28	7.32	2.70	72.10	2.15
Top blade steak (flat iron)	1166	8	7.88	2.11	72.25	1.83
Eye steak bnls	1102	32	8.92	2.53	70.41	2.19
Chuck average		330	6.58	3.10	72.59	2.41

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b] Universal product code.

Table 12
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef rib

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat (%)		Moisture (%)	
			Mean	SD	Mean	SD
Beef rib						
Roast large end	1218	3	9.15	2.81	70.59	2.36
Steak large end	1222	3	8.74	1.00	69.92	1.51
Back ribs	1182	33	11.67	3.48	67.81	2.85
Roast small end	1235	4	8.53	2.73	70.25	2.16
Roast small end bnls	1238	1	9.02		70.08	
Steak small end	1239	4	8.62	2.45	69.72	2.24
Steak small end bnls	1245	7	7.09	2.71	71.06	1.84
Ribeye steak	1209	46	7.97	3.18	70.61	2.46
Ribeye roast	1192	1	12.55		67.63	
Short ribs	1259	3	11.45	3.04	69.25	1.65
Short ribs bnls	1265	1	8.49		70.79	
Ribeye rst lip on BI	1193	7	7.75	2.28	70.58	1.62
Ribeye stk lip on BI	1197	45	7.58	2.59	70.63	1.92
Ribeye stk lip on bnls	1203	39	8.02	2.80	70.21	2.32
Rib average		197	8.61	3.23	70.00	2.47

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

chuck, and miscellaneous had significantly less ($P < 0.05$) external fat than cuts from the rib and loin. Average fat thickness for cuts from the round and chuck was 0.05 cm and retail cuts from the rib and loin had 0.11 cm of external fat. It is economically advantageous for retailers to sell beef steaks from the rib and loin with more external fat because of the value difference between fat left on a steak and that fat that is trimmed off. In order to show the contributions of individual retail cuts to these means, means and standard deviations for fat thickness from retail cuts from the chuck and rib surveyed in the store are found in Table 2, from the loin and round are shown in Table 3, and those from other miscellaneous beef cuts are in Table 4.

For a majority of the retail cuts represented in the National Nutrient Database, nutrient information is available for cuts with external fat thickness measurements of 1.27 cm, 0.6 cm, 0.3 cm, and 0.0 cm (USDA, 2006). However, much of the data in this study shows that, on average, many of the beef cuts at the retail level would have external fat thickness measurements that would lie between 0.3 cm and 0.0 cm. As a result of this, nutritional information for these products cannot be accurately derived from the data shown in the National Nutrient Database.

3.2. Separable tissue components

Retail cuts in this study were dissected into four basic separable components, separable lean, external fat, seam fat, and bone and heavy connective tissue. Data in Tables 5–9 show means and standard deviations for each of the separable components,

Table 13
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef loin

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat (%)		Moisture (%)	
			Mean	SD	Mean	SD
Beef loin						
Top loin steak	1398	21	7.74	2.86	70.39	2.05
Top loin steak bnls	1404	53	5.49	1.99	71.67	1.69
Tenderloin steak	1388	35	4.78	1.77	73.44	1.68
T-bone steak	1369	43	6.27	1.77	71.54	1.58
Porterhouse steak	1330	22	6.99	2.67	70.92	2.38
Sirloin steak	1358	1	5.27		72.81	
Shell sirloin steak	1346	1	6.26		70.28	
Ball tip roast	1307	4	3.85	1.57	72.75	2.14
Ball tip steak	1308	14	4.26	1.50	72.74	1.46
Flap meat steak	1326	1	5.70		74.11	
Tri tip roast	1429	12	7.57	2.98	70.99	2.41
Tri tip steak	1430	16	6.58	1.65	71.73	1.62
Top sirloin rst bnls cap off	1419	1	2.50		73.25	
Top sirloin steak bnls	1422	23	4.04	1.41	73.26	1.28
Top sirloin stk bnls cap off	1426	22	3.67	1.21	73.36	1.06
Top sirloin cap steak bnls	1421	4	4.72	0.97	72.85	0.65
Loin average		273	5.60	2.30	72.06	1.95

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

Table 14
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef round

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat (%)		Moisture (%)	
			Mean	SD	Mean	SD
Beef round						
Steak	1494	1	4.49		72.73	
Steak bnls	1501	16	2.83	1.79	74.12	1.51
Top round roast	1455	6	2.04	0.69	74.6	0.79
Top round roast cap off	1454	7	2.72	0.86	73.44	0.60
Top round steak, 1st cut	1556	6	3.31	2.16	73.46	1.54
Top round steak	1553	37	3.24	1.33	73.41	1.28
Bottom round rump roast	1519	20	4.74	1.87	73.03	1.68
Bottom round roast	1464	24	4.44	1.97	72.81	1.70
Bottom round steak	1466	27	5.24	2.38	72.41	1.78
Eye round roast	1480	24	3.30	0.94	73.96	1.10
Eye round steak	1481	28	3.07	1.01	73.79	1.11
Bottom round rst (triangle)	1463	2	8.79	0.71	69.98	0.26
Tip roast	1525	5	3.92	1.27	75.07	1.27
Tip steak	1527	10	3.55	1.34	74.33	1.15
Tip roast cap off	1526	3	2.87	0.56	74.72	0.59
Tip steak cap off	1535	17	3.15	1.29	74.64	0.90
Sirloin tip center steak	1550	7	4.44	2.33	73.58	1.58
Sirloin tip center roast	1549	4	4.42	1.13	74.68	1.06
Sirloin tip side steak	1543	8	2.91	0.83	74.54	0.97
Cubed steak	1577	31	3.72	1.57	73.63	1.50
Round average		283	3.71	1.77	73.59	1.52

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

Table 15
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for miscellaneous beef retail cuts

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat (%)		Moisture (%)	
			Mean	SD	Mean	SD
Beef shank cross cuts	1636	40	2.97	1.25	75.51	1.22
Beef Brisket						
Whole bnls	1615	3	6.24	1.29	72.96	1.19
Point half bnls	1628	1	6.57		71.87	
Flat half bnls	1623	14	3.90	1.79	74.66	1.76
Middle cut bnls	1626	2	5.07	0.81	74.07	0.97
Flat cut bnls	1622	14	4.86	1.82	73.86	1.57
Point off bnls	1629	6	3.81	1.00	74.42	0.64
Edge cut bnls	1624	1	6.64		71.50	
Beef flank steak	1581	38	5.72	1.92	72.77	1.65
Beef plate						
Skirt steak bnls	1607	23	9.81	4.71	69.92	3.81
Skirt steak rolls bnls	1611	5	8.58	2.89	70.18	2.48
Short ribs	1599	7	12.13	3.17	67.99	3.33
Spareribs	1598	1	12.07		68.40	
Short ribs bnls	1605	8	6.43	3.49	72.89	3.11
Short ribs flanken style	1603	10	13.61	4.03	67.69	3.04
Beef for stew	1727	42	4.26	1.50	73.75	1.54
Beef for stirfry		29	4.03	2.08	72.87	1.67
Miscellaneous average		244	5.63	3.66	72.93	2.91

[a] Uniform retail meat identity standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003).
[b] Universal product code.

as well as total separable fat for individual cuts. Table 10 shows least squares means and standard errors for each primal and the miscellaneous beef retail cut category. Cuts from the round had the highest ($P < 0.05$) percentage of separable lean compared to all other primals and categories (Table 10). Cuts from the rib had the lowest ($P < 0.05$) percentage (Table 10). As would be expected, the percentage of total separable fat decreased when the percentage of separable lean increased. Because of this, round cuts also had the lowest percentage of external and seam fat, resulting in the lowest percentage of total separable fat. This is partially because most round cuts are single-muscle cuts, which diminishes the amount of seam fat. Cuts from the rib had the lowest ($P < 0.05$) percentage of separable lean and highest ($P < 0.05$) percentage of total separable fat (Table 10). Specifically, back ribs produced a much lower numeric percentage (34.45%) for separable lean causing the overall lean percentage mean for rib cuts to be lower than its counterparts (Table 6). Savell et al. (1991) stated that it is expected that cuts from the rib and chuck to have higher percentages of seam fat than cuts from other primals because many of these are multiple muscle cuts. Results from this study support Savell et al. (1991) finding the rib and chuck cuts to have the highest percentages of seam fat. Unlike seam fat, external fat can be removed relatively easily from retail cuts, and after the release of the National Consumer Retail Beef Study (Cross et al., 1986; Savell et al., 1989), retailers made tremendous efforts to decrease the amount of external fat on cuts in the retail case. Innovative fabrication styles are being used more in industry today, and these account for some of the decrease in fat trim levels at retail; however, retailer product specifications have specific external fat thickness requirements for incoming product and may also have contributed to this decrease. Cobiac, Droulez, Leppard, and Lewis (2003) conducted a survey in Australia of retail outlets similar to the present study and the National Beef Market Basket Survey (Savell et al., 1991). Cobiac et al. (2003) stated that there was a wide variation in the percentage of total separable fat in the retail beef cut section. This variation could lead to difficulty in providing accurate nutrient composition data for beef retail cuts.

In general, boneless, closely-trimmed cuts tended to produce a higher percentage of separable lean than others. Additionally, steaks produced a higher percentage of separable lean than roast counterparts because of increased trimming during fabrication.

3.3. Extractable fat and moisture of separable lean

Chemical fat and moisture analyses were conducted on the separable lean component obtained from the dissection of each retail cut. Means and standard deviations for the percentages of extractable fat and moisture are presented in Tables 11–16. Table 17 displays the least squares means for percentage extractable fat and moisture of retail cuts from the chuck, rib, loin, and round primals, and other miscellaneous beef cuts. These data follow the same trend reported in the separable component results section with cuts from the round having the lowest percentage of extractable fat and rib cuts generating the highest ($P < 0.05$) percentage (Table 17). Mean extractable fat percentages for nine of the twelve ground beef classifications were lower than what was declared on the package label for fat percentage (Table 16). These results agree with findings from the previous National Beef Market Basket Survey (Savell et al., 1991). Mean percentages for extractable moisture tended to decrease as the percentage of extractable fat increased.

Table 16
Means and standard deviations for percentage extractable fat and moisture for ground beef

Declared lean/fat percentage	*n*	Extractable fat (%)		Moisture (%)	
		Mean	SD	Mean	SD
73/27	10	22.67	3.13	60.34	2.10
75/25	3	23.94	1.99	59.37	2.21
78/22	4	17.83	3.60	63.65	2.29
80/20	49	17.02	2.81	64.54	2.22
81/19	3	22.32	1.22	60.1	0.26
85/15	50	13.38	2.63	67.22	2.16
90/10	35	8.88	2.00	71.29	1.67
91/9	2	8.75	1.40	71.57	0.83
92/8	4	7.69	0.89	71.88	1.09
93/7	40	8.11	3.30	71.76	3.15
95/5	7	4.34	1.33	74.63	1.47
96/4	28	6.04	2.06	72.66	1.88
Ground beef average	235	13.41	7.06	67.42	5.57

Table 17
Least squares means ± SEM[a] for percentage extractable fat and moisture of retail cuts from the chuck, rib, loin, and round primals, and other miscellaneous beef cuts

Percentage	Chuck	Rib	Loin	Round	Misc	$P > F$
Extractable fat	6.90 ± 0.15d	8.61 ± 0.20e	5.60 ± 0.17c	3.71 ± 0.17a	4.99 ± 0.19b	<0.0001
Extractable moisture	72.36 ± 0.12b	70.00 ± 0.16a	72.06 ± 0.14b	73.59 ± 0.13c	73.36 ± 0.15c	<0.0001

Means within the same row lacking a common letter (a–e) differ $P < 0.05$.
[a] SEM is the standard error for least squares means.

These findings are similar to those reported by Jones, Savell, and Cross (1992b) and Wahrmund (1999).

4. Conclusions

Compared to the findings of the previous market basket survey (Savell et al., 1991), it is clear that beef in the current survey had less external fat and separable fat. It is important to continue to conduct market surveys such as these to have the most current information regarding beef retail cut composition available for those entities that need access to these data.

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